HEALTH CONSULTATION

An Evaluation of Mercury Concentrations in Fish from Desolation Canyon, Green River, Utah for 2000 and 2005

Desolation Canyon, Green River, Utah

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Prepared by

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Background and Statement of Issues

The Utah Department of Environmental Quality (UDEQ) collected fish from 36 different sites during the years 2000-2003. This sampling was in cooperation with a study developed by the Environmental Protection Agency (EPA) called the Environmental Monitoring and Assessment Program (EMAP). The primary goal of EMAP is to generate state and regional assessments of the state of ecological resources in the United States. Part of this study involves assessing contaminant levels in fish; mercury is one of the many contaminants analyzed. One of the sites sampled in 2002 was Desolation Canyon on the Green River. UDEQ requested that the Environmental Epidemiology Program (EEP) review the fish sampling data

In 2002, fish from Desolation Canyon were collected and analyzed for chemical contaminants that included heavy metals, volatiles, semivolatiles, PCBs, dioxins, and furans. The sampling site is shown in Figure 1. The data from 2002 indicated that channel catfish may have mercury concentrations at levels that may have an adverse effect on human health. Additional fish sampling was conducted in September 2005 by UDEQ to further characterize the mercury concentrations in channel catfish from Desolation Canyon. This health consultation is an evaluation of mercury in fish from Desolation Canyon, Green River covering the period 2002 and 2005.

Results

Fish Analysis for 2002

Mercury concentrations are reported as a wet weight concentration in milligrams of mercury per kg fish tissue (mg/kg). Fish from 2002 were analyzed individually, it is not known if the fish were analyzed as whole fish or as fillet portions (Table 1).

Three channel catfish were caught from Desolation Canyon on the Green River. Mercury levels ranged from 0.128 mg/kg to 0.307 mg/kg with an average of 0.225 mg/kg for channel catfish. Mercury levels in three smallmouth bass ranged from 0.127 mg/kg to 0.148 mg/kg with an average of 0.139 mg/kg. Three common carp had mercury levels ranging from 0.110 mg/kg to 0.114 mg/kg with an average of 0.111 mg/kg. One red shiner had a mercury concentration of 0.092 mg/kg.

Fish Analysis for 2005

Based on the results for mercury in channel catfish in 2002, more fish were collected and analyzed for mercury. Ten channel catfish were collected from Desolation Canyon in September 2005 and fillet portions from individual fish were analyzed for mercury levels (Table 2). The channel catfish had a wet weight mercury range of 0.24 mg/kg to 0.91 mg/kg with an average value of 0.51 mg/kg.

Discussion

Screening values (SVs) were developed by the U.S. Environmental Protection Agency (EPA) and are used as standards by which levels of contamination can be compared. Screening values are defined as the concentrations of target analytes in fish tissue that can trigger further investigation and/or consideration of fish advisories for the waterbodies and species where such concentrations occur [EPA 2000b].

The amount of mercury in fish tissue tends to increase with the age and size of the fish. Fish-eating species of fish also accumulate higher concentrations of mercury than non-piscivorous fish [EPA 2000b].

In fish tissue, the majority of mercury is methylmercury. Methylmercury is rapidly absorbed from the gastrointestinal tract. The body absorbs about 90 to 100 percent of ingested methylmercury. Methylmercury can be changed by your body to inorganic mercury. When this happens in the brain, the mercury can remain there for a long time. When methylmercury does leave your body after you have been exposed, it leaves slowly over a period of several months, mostly as inorganic mercury in the feces. The biological half-life of methylmercury in humans is roughly 50 to 65 days. The half-life is a measure of rate for the time required to eliminate one half of a quantity of a chemical from the body. As with inorganic mercury, some of the methylmercury in a nursing woman's body will pass into her breast milk [ATSDR 1999].

Results of the 2002 mercury concentrations in fish from Desolation Canyon were compared to the SV. The SV for mercury is 0.3 milligrams mercury per kilogram fresh fish weight (mg/kg) [EPA 2000a]. Only one channel catfish sample from Desolation Canyon exceeded the SV for mercury. The average mercury concentration for channel catfish did not exceed the SV.

Eight out of the ten channel catfish collected in September 2005 exceeded the 0.3 mg/kg SV for mercury. The average mercury concentration was 0.51 mg/kg.

The nervous system is very sensitive to all forms of mercury. In poisoning incidents that occurred in other countries, some people who ate fish contaminated with large amounts of methylmercury or seed grains treated with methylmercury or other organic mercury compounds developed permanent damage to the brain and kidneys. Animals exposed orally to long-term, high levels of methylmercury or phenylmercury in laboratory studies experienced damage to the kidneys, stomach, and large intestine; changes in blood pressure and heart rate; adverse effects on the developing fetus, sperm, and male reproductive organs; and increases in abortions and stillbirths [ATSDR 1999].

The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) are advising women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and to only eat fish and shellfish that are lower in mercury [EPA 2004]. The types of fish to avoid include shark, swordfish, king mackerel or tilefish because they contain high levels of mercury. Up to 12 ounces (2 average meals) a week of a variety of fish and shellfish can be eaten that are lower in mercury. The most commonly eaten

fish that are low in mercury are shrimp, canned light tuna, salmon, pollock and catfish. Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. Up to 6 ounces (one average meal) of albacore tune can be eaten per week.

Consumption Limits

When SVs are exceeded, consumption limits can be estimated to determine how many meals of fish can be safely consumed each month [EPA 2000b]. Calculations are based on an adult body weight of 70 kg with a meal size of 227 g fish and a child body weight of 16 kg with a meal size of 113 g of fish (Appendix A).

Based on an average mercury concentration of 0.51 mg/kg in channel catfish, adults can safely eat 2 eight-ounce meals per month; and women who may become pregnant, pregnant women, nursing mothers, and young children can eat 1 four-ounce meal per month of channel catfish from Desolation Canyon.

Children's Health Considerations

Infants and children have unique vulnerabilities to environmental contaminants. Children are less developed and may have developmental harm from exposure that would not be experienced by a completely developed adult. The developing body systems of children may sustain permanent damage if toxic exposures occur during critical growth stages. Children's health was considered as a part of this health consultation.

Very young children may be more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also pass to a nursing infant through breast milk. However, the benefits of breast-feeding may be greater than the possible adverse effects of mercury in breast milk. Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage [ATSDR 1999].

Due to the possible health effects from chemical contaminants on the fetus, pregnant women should follow the consumption limits assigned to children.

Conclusions

Channel catfish collected from Desolation Canyon have levels of mercury that may result in a risk of adverse health effects. Based on higher fish consumption rates, the potential for adverse health effects is higher for those consuming fish at a subsistence level. The EEP is not aware of people using this site for subsistence fishing. Based on the nature of the contaminant, it is highly likely that exposure has occurred, continues to occur, and will exist in the future for those people that catch and consume channel catfish from the site. The route of exposure is through ingestion of contaminated fish.

Fish consumption of channel catfish from Desolation Canyon should be limited to 2 eight-ounce meals per month for adults and 1 four-ounce meal per month for women who may become pregnant, pregnant women, nursing mothers, and young children.

Recommendations

The Environmental Epidemiology Program recommends a fish advisory for Desolation Canyon because of the levels of mercury detected in channel catfish. Fish consumption of channel catfish from Desolation Canyon should be limited to 2 eight-ounce meals per month for adults and 1 four-ounce meal per month for women who may become pregnant, pregnant women, nursing mothers, and young children.

The EEP recommends that concentrations of mercury, PCBs, pesticides and other chemicals continue to be monitored in game fish from Desolation Canyon.

Public Health Action Plan

The Environmental Epidemiology Program of the Utah Department of Health will continue to work with the Utah Department of Environmental Quality, the Utah Division of Wildlife Resources, Southeastern District Health Department, and the TriCounty Health Department to notify the public of the findings of this health consultation. A press release and fact sheet will be prepared to inform the public of the fish consumption advisory. A copy of this Health Consultation and the fish advisory will be posted on the EEP web site.

The Environmental Epidemiology Program will continue to work with all applicable agencies to perform additional research on mercury, PCBs, and other chemical contaminants in fish in Utah. The Environmental Epidemiology Program will adjust recommendations as new information becomes available.

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Figure and Tables

Figure 1. Location of sampling site on map of Utah.

Table 1. Mercury results for individual fish fillet samples from Desolation Canyon, Green River, Utah (2002).

Species	Concentration (mg/kg)*
Channel catfish	**0.307**
Channel catfish	0.128
Channel catfish	0.291
Average =	0.225
Smallmouth bass	0.143
Smallmouth bass	0.148
Smallmouth bass	0.127
Average =	0.139
Common carp	0.114
Common carp	0.111
Common carp	0.110
Average =	0.111
Red shiner	0.092

Fish samples collected by Utah Department of Environmental Quality.
Values that exceed the SV are shown in bold.
* Wet weight concentrations of contaminants from composite analysis.

Table 2. Mercury results for individual channel catfish fillet samples from Desolation Canyon, Green River, Utah (2005).

Sample	Mercury concentration (mg/kg)*
4933061-CCF-01	**0.54**
4933061-CCF-02	**0.38**
4933061-CCF-03	**0.56**
4933061-CCF-04	**0.35**
4933061-CCF-05	**0.81**
4933100-CCF-01	0.28
4933100-CCF-02	**0.91**
4933100-CCF-03	**0.32**
4933100-CCF-04	**0.70**
4933100-CCF-05	0.24
Average =	**0.51**

Fish samples collected by Utah Department of Environmental Quality.
Values that exceed the SV are shown in bold.
* Wet weight concentration.

Appendix

Screening Value and Consumption Limit Calculations

For Noncarcinogenic Health Effects

$SV = [(MRL)(BW)]/CR$

SV = Screening value for a contaminant (in mg/kg or ppm)
MRL = Minimal risk level (in mg/kg/day)
BW = Mean body weight of the general population or subpopulation of concern (kg)
CR = Mean daily consumption rate of the species of interest by the general population or by the subpopulation of concern averaged over a 70-yr lifetime (in kg/day)

Consumption Rate Calculations for Non-Carcinogenic Health Effects

To calculate the maximum allowable fish consumption rate for a non-carcinogen:

$CR_{lim} = [(RfD)(BW)]/C_m$

Channel catfish	RfD	BW	C_m	CR_{lim}
Adult	0.0001	70	0.51	0.0137
Child	0.0001	16	0.51	0.0031

Where:
CR_{lim} = maximum allowable fish consumption rate (kg/day)
RfD = reference dose (EPA) or minimal risk level (ATSDR)
BW = mean body weight of the general population or sub-population of concern (kg)
C_m = measured concentration of chemical contaminant in a given species of fish (mg/kg)

$CR_{mm} = [(CR_{lim})(T_{ap})]/MS$

Channel catfish	CR_{lim}	T_{ap}	MS	CR_{mm}
Adult	0.0137	30.44	0.227	1.8
Child	0.0031	30.44	0.113	0.8

Where:
CR_{mm} = maximum allowable fish consumption rate (meals/month)
CR_{lim} = as calculated above
T_{ap} = time averaging period (365.25 days/12 months = 30.44 days per month)
MS = meal size (0.227 kg fish/meal for adults, 0.113 kg fish/meal for children)

Assumptions for Consumption Rate Calculations are as follows:

An average adult weighs 70 kg and eats 227 g of fish per meal.

An average child weighs 16 kg and eats 113 g of fish per meal.